Title	***R&D into Improved Coupling Control for the SR***			
Project Requestor	Michael Borland			
Date	March 21, 2008			
Group Leader(s)	Borland, Moog			
Machine or Sector Manager	Louis Emery			
Category	Accelerator Hardware and ID Upgrades			
Content ID*	APS_1257987	Rev.	ICMS_Revision	ICMS Document Date

*This row is filled in automatically on check in to ICMS. See Note [1]

Description:

Start Year (FY)	**2009**	**Duration (Yr)**	**3**

Objectives:

To improve the ability to tune the coupling for lifetime and injection efficiency. To improve the ability to control beam tilts seen by users.

Benefit:

Controlling the lifetime and injection efficiency will help protect insertion devices and other accelerator components from suffering radiation damage due to electron beam losses. To improve the ability to control beam tilts seen by users.

Risks of Project: See Note [2]

Low.

Consequences of Not Doing Project: See Note [3]

Benefits not realized.

Cost/Benefit Analysis: See Note [4]

For the most part, this is an R&D project involving simulation; additional cost is negligible.

Description:

This is part of a multi-proposal initiative aimed at reducing radiation damage and making other operational improvements to the SR. (See Section 1 of OAG-TN-2008-008 for a full description and explanation of the linkage among the parts).

Improved coupling control will allow us to set the vertical emittance to a desired value (for lifetime) while keeping to a minimum the coupling of injection transients into the vertical plane. This will reduce injected beam losses at IDs. One component of such a project
could be addition of skew quadrupole windings to about 15 corrector magnet cores in the non-user parts of the APS (OAG-TN-2008-006). This might need to be combined with additional skew quadrupoles (implemented in the same fashion) in each sector of the ring. We propose to develop a physics concept for upgraded skew quadrupoles and then participate in the implementation.

This project will work with the other project **"**Multi-location Vertical Beam Size Measurement for the SR" (ICMS APS_1257983), which is R&D on determining how best to provide the required vertical beam size readings around the ring.

We should also study and consider a simpler method for vertical beam size control, driving the vertical tune, which is used at ESRF. This method has some complexities and drawbacks, however, particularly as the bunch pattern varies due to top-up and short lifetime. A gated scheme (e.g., to target only the hybrid bunch in hybrid mode), such as one made possible by FPGA technology, may address some of these concerns. We presently have most of the equipment. We could also upgrade to the latest version of FPGA kit to provide better rise and fall time. We can also require an optimized stripline for reduced amplifier power.

Funding Details

Cost: ($K)
Use FY08 dollars.

Cost estimates difficult at this point. We assume 0.2 FTE physicist for the first year to work out concepts of which of the schemes would work better: a set of skew quadrupole correctors or driving the tune. For skew quadrupole coil engineering the engineering effort would be either 0.2 FTE if we reuse present corrector coils for creating skew quadrupole field, or 0.4 FTE if new coils need to be designed for the corrector magnets (to create combined function skew quadrupoles-dipole magnets).

The effort for tune driving is 0.1 FTE software, 0.1 FTE technician, 0.05 FTE physicist. If an optimized stripline is required, then we add 0.2 electrical engineer. If a new FPGA is required, then add 0.1 FTE software, 0.1 FTE technician. The effort table below assumes the two options.

The sum of the effort for the tune driving design and implementation and the skew quadrupole design is given in the table. Not included is the actual work on the real corrector magnets if that is the decision.

A new FPGA kit is $2.5k.

Year	AIP	Contingency
1	$2.5k	
2		
3		
4		
5		
6		
7		
8		
9		
Total	0	

Contingency may be in dollars or percent. Enter figure for total project contingency.

Effort: (FTE)

Year	Mechanical Engineer	Electrical Engineer	Physicist	Software Engineer	Tech	Designer	Post Doc
1	0.2-0.4	0.2	0.25	0.2	0.2		
2							
3							
4							
5							
6							
7							
8							
9							

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[1] **Notes:**

ICMS. Check in first revision to ICMS as a *New Check In*. Subsequent revisions should be checked in as revisions to that document i.e. C*heck Out* the previous version and C*heck In* the new version. Be sure to complete the *Document Date* field on the check in screen.

[2] **Risk Assessment.** Advise of the potential impact to the facility or operations that may result as a consequence of performing the proposed activity. Example: If the proposed project is undertaken then other systems impacted by the work
include ... (If no assessment is appropriate then enter NA.)

[3] **Consequence Assessment.** Advise of the potential consequences to the facility or to operations if the proposal is not executed. Example: If the proposed project is not undertaken then ____ may happen to the facility. (If no assessment is appropriate then enter NA.)

[4] **Cost Benefit Analysis.** Describe cost efficiencies or value of the risk mitigated by the expenditure.
Example: Failure to complete this maintenance project will result in increased total costs to the APS for emergency repairs and this investment of ___ will also result in improved reliability of ____. (If no assessment is appropriate then enter NA.)